

Original Research Article

Correlation of body mass index and waist/hip ratio with severity of coronary artery disease

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ABSTRACT

Background: Obesity assessed by body mass index (BMI) and waist/hip ratio (WHR) are better predictors of cardiovascular disease. However, there is a dearth of data investigating the correlation of BMI and WHR with severity of CAD, particularly among the Indian population. This study aims to investigate the correlation of BMI and WHR with severity of CAD assessed by angiography.

Methods: This open-label observational study included patients who underwent angiography, angioplasty, or coronary artery bypass grafting in the past one month. All data such as age, gender as well as anthropometric measurements such as height (meters), weight (kg), and waist circumferences (cm), and hip circumferences (cm) were collected at the first follow-up visit. BMI (kg/m²), body surface area (BSA) (m²), and WHR were calculated. Angiography findings were retrieved from the patient's own record to note the severity of CAD.

Results: In total, 302 patients were analyzed. The mean age of the study sample was 60.5±11.5 years, and 71.9% were males. Mean BMI, BSA, and WHR were 27.0±4.3 kg/m², 1.3±0.8 m² and 0.96±0.07, respectively. BMI was not significantly correlated with severity of CAD (p=0.051). In both male and female patients, WHR was not significantly correlated with severity of CAD (male: p=0.256 and female: p=0.851).

Conclusions: It has been concluded that BMI and WHR were not significantly correlated with severity of CAD in an Indian population.

Keywords: Cardiovascular diseases, Coronary angiography, Obesity, Single-vessel disease, Double-vessel disease, Triple-vessel disease

INTRODUCTION

Obesity (also referred to as “abdominal obesity”) is defined as excessive body fat, and it is mainly caused by a sedentary lifestyle. According to World Health Organization (WHO), overweight is defined as body mass index (BMI) of 25 kg/m² to 29.9 kg/m² and obesity as a BMI of 30 kg/m² or more.¹ As a consequence of the myriad health problems associated with obesity, it is presently estimated to be the second major cause of

preventable mortality.² Earlier obesity was considered a problem of the developed world; nevertheless, the burden of obesity has increased significantly over the past few decades in India. According to ICMR–INDIAB study published in 2015, the prevalence rate of obesity ranges from 11.8% to 31.3% in India.³ There is abundant epidemiological evidence of a strong association between obesity and wide spectrum of cardiovascular diseases (CVD) including hypertension, coronary heart disease, stroke, atrial fibrillation, heart failure, and sudden cardiac death.⁴⁻⁷

In order to prognosticate risks of CVD, various anthropometric measurements like BMI, waist/hip ratio (WHR), and waist circumference have been extensively used for the estimation of abdominal obesity.^{8,9} BMI usually reflects general obesity, while waist circumference and WHR are linked to central obesity and fat distribution. Few studies have demonstrated correlation of BMI and WHR with severity of CAD; nonetheless, only limited data exist for an Indian population.¹⁰⁻¹³ With this background, this study was designed to examine the correlation of BMI and WHR with severity of CAD in terms of normal coronary artery, single-vessel disease (SVD), double-vessel disease (DVD), and triple-vessel disease (TVD).

METHODS

It was an open-label observational study conducted at Narindra Heart Clinic, Pune, India from September 2019 till December 2020. Patients who underwent angiography, angioplasty, or coronary artery bypass grafting in the past one month of recruitment were included. The exclusion criteria were: a) patients who had undergone procedure >4 weeks earlier, b) patients who reported major weight change and c) patients whose detailed angiographic reports were not available.^{14,15}

All anthropometric measurements were taken at first follow-up after obtaining written consent from enrolled patients. Body height was measured in the standing position without shoes. Body weight was measured without shoes and with light clothing. Waist circumference was measured at the mid-point between the distal border of the ribs and the top of the iliac crest with subjects standing at the end of a normal expiration. Hip circumference was measured around the widest part of the buttocks, with the tape parallel to the floor. Next, BMI, body surface area (BSA), and WHR were calculated using the standard equations: BMI=weight (kg)/height² (m²); BSA (m²)=(height (cm) x weight (kg)/3600)^{1/2} (Mosteller method); WHR=waist circumference/hip circumference. BMI was classified as follows: underweight (under 25 kg/m²), normal weight (25 to 30 kg/m²), overweight (30 to 35 kg/m²), and obese (35 kg/m² or more).¹⁶ The cutoffs points (Asians) of

WHR used were: >90 cm in men and >80 cm in women.¹⁷

All patients were subjected to two-dimensional (2D) echocardiography and color doppler. All angiographic and revascularization details were retrieved from patients' records. The severity of CAD was measured according to the number of diseased vessels, and categorized as: normal coronary arteries, mild CAD, SVD, DVD, and TVD.

Ethical approval has been taken from Institutional Ethics Committee (IEC) and study was conducted in accordance with Declaration of Helsinki.

Analysis was carried out using the Statistical Package for Social Sciences (SPSS) Ver.18.0 software (SPSS Inc., Chicago, IL, USA). Continuous variables are reported as mean and standard deviation while categorical variables are presented as numbers and percentage. Chi-Square test of independence was used to determine an association between categorical variables.

RESULTS

During the period of April 2021 to September 2021, data of 302 individuals were assessed. The mean age of the study sample was 60.5±11.5 years, males were predominant (71.9% vs. 28.1%) with male-female ratio of 2.6:1. It was noted that most of the patients having obesity belonged to the 6th decade (32.8%) followed by the 5th decade (27.2%). Mean BMI, BSA, and WHR were found to be 27.0±4.3 kg/m², 1.3±0.8 m², and 0.96±0.07, respectively. Thirty-four patients (11.3%) had normal coronary arteries, 7 (2.3%) patients had mild CAD, 150 (49.7%) patients had SVD, 69 (22.8%) patients had DVD, and 42 (13.9%) patients had TVD. The remaining baseline characteristics of the patients are presented in Table 1.

As depicted in Table 2, BMI was not significantly correlated with severity of CAD (p=0.051). There was not significant correlation between WHR and severity of CAD in both males and females with p value of 0.256, and 0.851, respectively (Table 3).

Table 1: Baseline characteristics of study patients.

Patient characteristics	Total patients (n=302) N (%)
Age groups (yrs)	
21-30	2 (0.7)
31-40	12 (4.0)
41-50	49 (16.2)
51-60	82 (27.2)
61-70	99 (32.8)
71-80	49 (16.2)
81-90	9 (3.0)

Continued.

Patient characteristics	Total patients (n=302) N (%)
Male	217 (71.9)
History	
Hypertension	51 (16.9)
Diabetes mellitus	44 (14.6)
Height (cm)	161.5±9.3
Weight (kg)	70.6±13.0
Body mass index (kg/m ²)	27.0±4.3
Body surface area (m ²)	1.3±0.8
Waist (cm)	97.9±9.5
Hip (cm)	101.8±8.3
Waist/hip ratio for male	
<0.95	53/217 (24.4)
≥0.95	164/217 (75.6)
Waist/hip ratio for female	
<0.80	3/85 (3.5)
≥0.80	82/85 (96.5)
Left ventricular ejection fraction	
Poor (≤35%)	16 (5.3)
Moderate (>35% to 60%)	117 (38.7)
Good (≥60%)	169 (56.0)
Severity of coronary artery disease	
Normal	34 (11.3)
Mild CAD	7 (2.3)
SVD	150 (49.7)
DVD	69 (22.8)
TVD	42 (13.9)

†Data are reported as mean and standard deviation or numbers and percentages. CAD: Coronary artery disease, SVD: Single-vessel disease, DVD: Double-vessel disease; TVD: Triple-vessel disease.

Table 2: Body mass index according to severity of coronary artery disease.

Body mass index (kg/m ²)	Total patients (%) (n=302)	Normal coronaries (%) (n=34)	Mild CAD (%) (n=7)	SVD (%) (n=150)	DVD (%) (n=69)	TVD (%) (n=42)	P value
<25	92 (30.5)	4 (11.8)	3 (42.9)	42 (28.0)	23 (33.3)	20 (47.6)	0.051
25–30	154 (51.0)	24 (70.6)	3 (42.9)	81 (54.0)	32 (46.4)	14 (33.3)	
30–35	40 (13.2)	2 (5.9)	0 (0.0)	21 (14.0)	11 (15.9)	6 (14.3)	
>35	16 (5.3)	4 (11.8)	1 (14.3)	6 (4.0)	3 (4.3)	2 (4.8)	

† Data are reported as numbers and percentages. CAD: Coronary artery disease, SVD: Single-vessel disease, DVD: Double-vessel disease; TVD: Triple-vessel disease.

Table 3: Waist-hip ratio according to severity of coronary artery disease according to gender.

Waist-hip ratio	Normal coronaries (%)	Mild CAD (%)	SVD (%)	DVD (%)	TVD (%)	P value
Male						
	n=18	n=5	n=109	n=51	n=34	
<0.95	8 (44.4)	1 (20)	26 (23.9)	9 (17.6)	9 (26.5)	0.256
≥0.95	10 (55.6)	4 (80)	83 (76.1)	42 (82.4)	25 (73.5)	
Female						
	n=16	n=41	n=18	n=8	n=2	
<0.80	1 (6.2)	2 (4.9)	0 (0)	0 (0)	0 (0)	0.851
≥0.80	15 (93.8)	39 (95.1)	18 (100)	8(100)	2 (100)	

† Data are reported as numbers and percentages. CAD: Coronary artery disease, SVD: Single-vessel disease, DVD: Double-vessel disease; TVD: Triple-vessel disease.

DISCUSSION

Framingham Heart Study, a long-term research project with large sample size, was expected to be the cherry on the cake, yielding definite evidence for the importance of anthropometric measurements of general and central obesity in determining the risk assessment for CVD.¹⁸ Herein, the correlation of BMI and WHR with severity of CAD among an adult Indian population were assessed. From the present study, two main findings have been concluded: a) BMI was not significantly correlated with severity of CAD, b) WHR was not significantly correlated with severity of CAD in both male and female.

As stated above, WHR is usually used as measurements of central or visceral obesity, whilst BMI is indicative of overall obesity. Abdominal obesity is an independent risk factor for CAD and it is more relevant as opposed to overall obesity. In their study on 770 patients with CAD, Niraj and colleagues demonstrated an inverse relationship between severity of CAD and BMI.¹⁹ Similarly, another study published in 2015 by Parsa and colleagues reported a negative correlation between severity of CAD and BMI, according to both SYNTAX and Duke scores ($p \leq 0.001$ and $p = 0.001$, respectively), however the scenario was reverse for WHR according to the Duke score ($p = 0.03$). Contrary to this finding, it has been reported a significant positive correlation ($r = 0.296$, $p = 0.006$) between BMI and CAD score in patients with significant CAD (scores ≥ 7), while negative correlation was found in patient with non-significant CAD (scores < 7).²⁰ Rashiti et al showed a significant positive correlation between WHR and presence of severity of CAD among Kosovar patients.¹² The study done by Siavash et al wherein they demonstrated a significant positive correlation between CAD score and WHR ($p < 0.01$) in male patients.²¹ In this study, BMI and WHR were not significantly correlated with severity of CAD. Is obesity overrated as a modifiable risk factor of CAD? And being thin or being in ideal BMI range or small waist may not really mean being fitter.

Some limitations of this study warrant mention. First, the study design with a relatively small sample size of patients; and second, waist circumference was also reported as independent risk factor for the presence of significant CAD in literature, which was not examined in our study. Last but not least, there are chances of changing weight and WHR as parameters were taken on follow-up visits within the first one month of the procedures.

CONCLUSION

This study provides evidence that both BMI and WHR was not significantly correlated with severity of CAD among Indian population. Further studies with larger patient groups are needed to clarify the relationship of BMI and WHR with the severity of CAD.

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Conflict of interest: None declared

Ethical approval: The study was approved by the Institutional Ethics Committee

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